

AD _____

Award Number: W81XWH-08-2-0124

TITLE: Neural and Behavioral Sequelae of Blast-Related Traumatic Brain Injury

PRINCIPAL INVESTIGATOR: Stephen M. Rao, Ph.D.

CONTRACTING ORGANIZATION: Cleveland Clinic Foundation
Cleveland OH 44195

REPORT DATE: September 201F

TYPE OF REPORT: Annual

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for Public Release;
Distribution Unlimited

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.

REPORT DOCUMENTATION PAGE			<i>Form Approved</i> <i>OMB No. 0704-0188</i>		
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE (DD-MM-YYYY) Ugr vgo dgt '4233		2. REPORT TYPE Annual		3. DATES COVERED (From - To) 01 SEP 2032 - 31 AUG 2013	
4. TITLE AND SUBTITLE Neural and Behavioral Sequelae of Blast-Related Traumatic Brain Injury			5a. CONTRACT NUMBER "		
			5b. GRANT NUMBER Y : 3Z Y J /2: /4/2346		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S) Stephen M. Rao, Ph.D. go ckn'tcqu4B eeh0ti			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Cleveland Clinic Foundation Cleveland OH 44195			8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) US Army Med Research Acq Act 820 Chandler Street Fort Detrick, MD 21702-5014			10. SPONSOR/MONITOR'S ACRONYM(S)		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT Traumatic brain injuries (TBI) are a common occurrence from roadside blasts of improvised explosive devices (IEDs). In the proposed cross-sectional study, we aim to apply neurobehavioral testing and advanced MRI techniques [task-activated functional MRI (fMRI) and diffusion tensor imaging (DTI)] to gain a comprehensive understanding of the neural changes underlying blast-related MTBI. We will accomplish this goal by conducting advanced neuroimaging (task-activated fMRI and DTI fiber tracking) and neurobehavioral testing (computerized assessment and standard neuropsychological testing) on 60 chronic trauma patients: 15 military MTBI patients who have experienced blast injuries, 15 civilian MTBI patients with mechanical closed head injuries, 15 military and 15 civilian patients with orthopedic injuries. Year one of the project has been devoted to the development of the necessary infrastructure for the execution of this complex multisite study. A number of development tasks have been undertaken, including hiring and training a new coordinator in Houston, developing uniform procedures for analysis of image data in Cleveland and Houston, and further developing the avenues for recruitment of subjects. We have recruited 32 subjects and acquired imaging and cognitive data from 25 of these subjects. We are satisfied that the accrual of data is of high reliability and integrity. Over the next year, we will continue recruitment, acquisition of data, and data analysis across the two study sites.					
15. SUBJECT TERMS Blast-related traumatic brain injury (TBI), fMRI, DTI, cognition					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES 6	19a. NAME OF RESPONSIBLE PERSON
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			19b. TELEPHONE NUMBER (include area code)

Table of Contents

Introduction.....	3
Body	3
Key Research Accomplishments	4
Reportable Outcomes.....	5
Conclusion	5
References.....	5
Appendices.....	5
Supporting Data	5

INTRODUCTION

Traumatic brain injuries (TBI) are a common occurrence from roadside blasts of improvised explosive devices (IEDs). Like civilian TBI, blast-related TBI can result from mechanical forces in which objects in motion strike the head or the head is forcefully put into motion and strikes an object. TBI from exposure to an explosive blast may also result from a third cause: barotrauma. Blasts produce wave-induced changes in atmospheric pressure, which in turn produce characteristic injuries to vulnerable bodily regions at air-fluid interfaces, such as the middle ear. It is unknown whether the neural and cognitive sequelae of blast-related TBI differ from those resulting from mechanically-induced TBI commonly observed in civilian accidents. Understanding the potentially unique sequelae of blast-related TBI is critical for accurate diagnosis and designing effective pharmacological and neurorehabilitation interventions.

In the proposed cross-sectional study, we aim to apply neurobehavioral testing and advanced MRI techniques [task-activated functional MRI (fMRI) and diffusion tensor imaging (DTI)] to gain a comprehensive understanding of the neural changes underlying blast-related MTBI. This will be accomplished by comparing neurobehavioral and neuroimaging findings obtained from military personnel who have experienced a blast injury with those obtained from civilians who have experienced TBI from motor vehicle accidents and from military and civilian control participants with orthopedic injuries. We will accomplish this goal by conducting advanced neuroimaging (task-activated fMRI and DTI fiber tracking) and neurobehavioral testing (computerized assessment and standard neuropsychological testing) on 60 chronic trauma patients: 15 military MTBI patients who have experienced blast injuries, 15 civilian MTBI patients with mechanical closed head injuries, 15 military and 15 civilian patients with orthopedic injuries.

BODY

Year three of the project was devoted to the recruitment of participants and successful acquisition of imaging data for this complex multisite study. In addition, neuropsychological data collection has been stored in an Access database and image processing has been completed on individual participants and stored on a secure sever. We are pleased to report that the problems with recruitment noted in previous reports are being rectified. Details regarding each of these tasks are provided below, broken down by category.

Staff Recruitment, Employment, Organization, Training. We have no changes in personnel.

Neuropsychological and Neurobehavioral Measures

We are in the process of collecting brain imaging data and data on all outcome measures. All forms have been scored and entered into an Access database. All electronic files have been backed up on a local drive.

MRI

- Brain Imaging Protocols: Combining brain imaging data across two research sites is a considerable technical challenge. Extensive work has been done to establish a good matching of the scan parameters and to confirm the acquisition of comparable, high quality images for the Cleveland Clinic and Houston scanners (all are Siemens 3T MRI scanners).
- fMRI, DTI, and MRI Volumetric Data Acquisition: During the past year, we requested and were granted permission to revise inclusion criteria for the military control group. We had been experiencing considerable difficulties recruiting combat military personnel who experienced orthopedic injuries not related to blast-related causes. Inclusion criteria were loosened to include any combat military personnel who had not experienced a blast-related TBI. All image data have been placed on a secure server at Cleveland Clinic and are then transferred and archived at the image analysis laboratories in both Houston and Cleveland.

- fMRI Data Analysis: All fMRI datasets have been checked for image quality, with no task runs being excluded due to scanner artifact and few excluded due to motion. Current efforts for processing and analysis of the data are focused on the development of different, but complementary image analysis procedures at the Houston and Cleveland sites to provide convergent validation of the results. The Cleveland site is currently undertaking the analyses of fMRI data associated with the Stop Signal Task; the Baylor site is analyzing data from the Sternberg Working Memory Task.
- DTI, Volumetric MRI Data Analysis: We are up to date in the analysis of MRI volumetric data of brain regions. In addition we are in the process of analyzing the DTI data.
- Cleveland Recruitment: As of 8/31/2011, the Cleveland Clinic site has imaged 14 military TBI subjects, 9 military control subjects, 12 civilian TBI subjects, and 13 civilian orthopedic injury control subjects. Our recruitment goal was 60 participants (15 in each group). Thus we have met 80% (48/60) of our recruitment goal. We have requested and been granted a six month no cost extension (NCE and anticipate that we will have achieved 100% recruitment by the end of the NCE (2/28/11).

KEY RESEARCH ACCOMPLISHMENTS

At this point in the project, the key accomplishments have been the recruitment of 48 (80%) of the subjects at Cleveland site. This solid foundation permits us to make continued and consistent progress in data analysis. We anticipate a productive and efficient process based on the painstaking and meticulous work that has been put in to this point. To summarize, key accomplishments have been:

- Recruiting a total of 48 subjects in Cleveland.
- Development, testing, and implementation of comparable fMRI data analysis strategies for both the Houston and Cleveland sites
- fMRI, volumetric MRI, and DTI scanning completed for 48 Cleveland subjects.
- Initial development of complementary procedures for analysis of the fMRI group data.

REPORTABLE OUTCOMES

Given that we have not as yet met our enrollment goals, the products of our labor are not yet tangible. While engaged in recruitment and acquisition of data, we have devoted time to set up comparable image analysis procedures in Cleveland and Houston, attending to detail, ensuring the integrity and reliability of the data we will use to arrive at the reportable outcomes. We are engaged in data analysis while we are enrolling additional patients. We anticipate that we will have reportable outcomes within the next six months.

CONCLUSION

The first year of the project was devoted to creating a viable infrastructure to support the collection of data across multiple sites. The second and third years of the project were devoted to the recruitment of subjects. The Cleveland site has made significant progress in recruitment of the subjects and should fully enroll the study by the end of the NCE.

REFERENCES

Given that we are not yet reporting data, we have no references at this time.

APPENDICES

None at this time

SUPPORTING DATA

None at this time